Compact Ocean Wind Vector Radiometer (COWVR)

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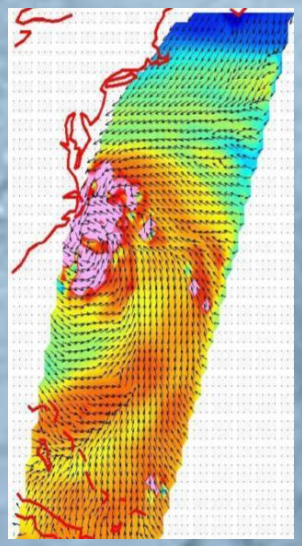
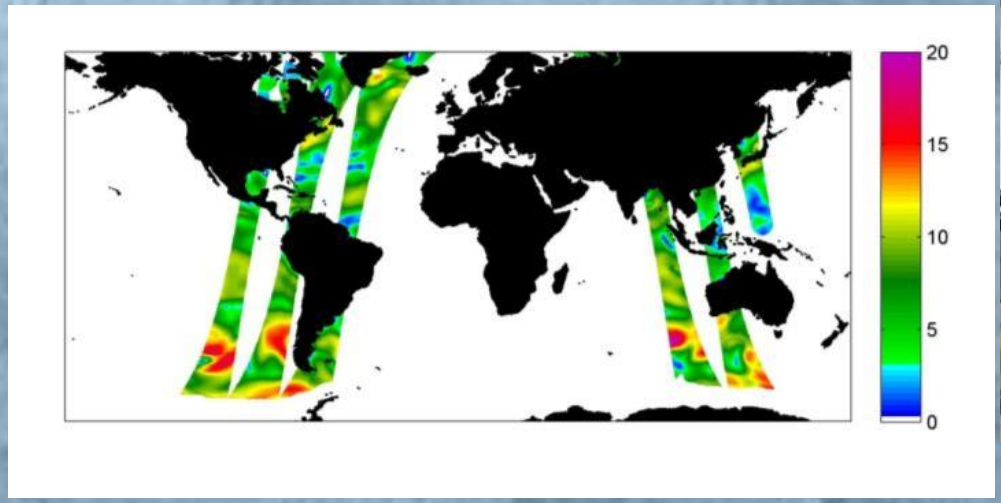
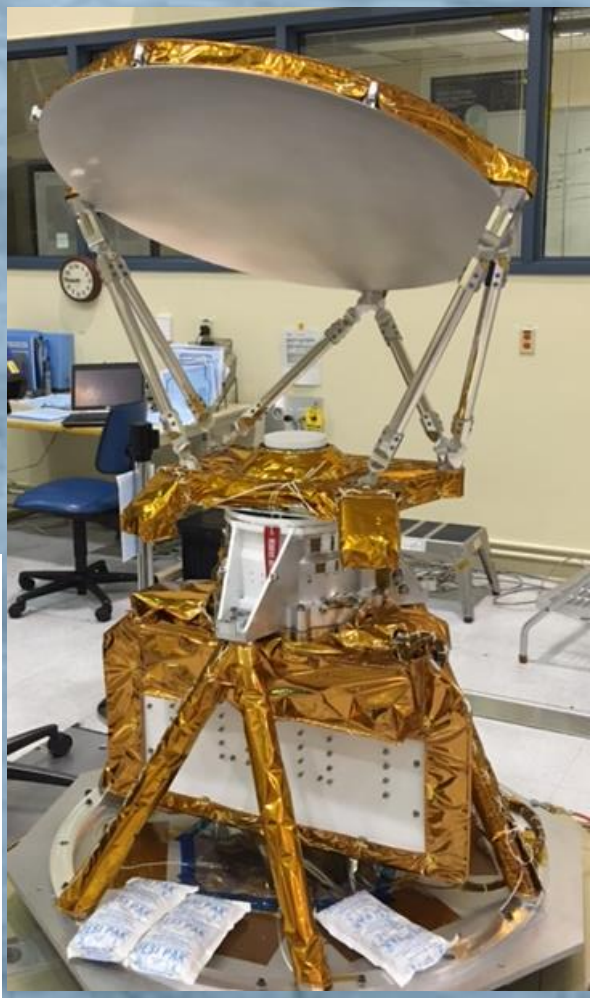
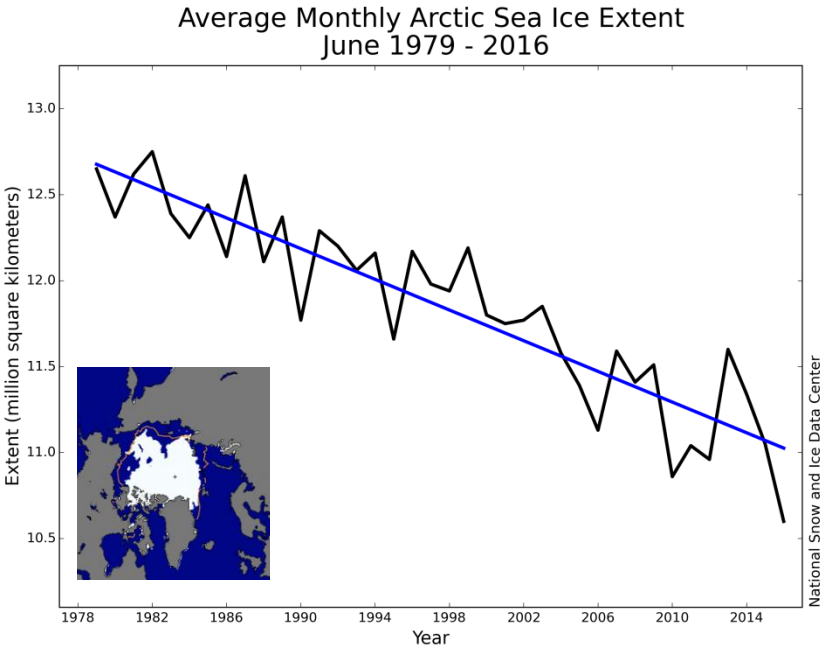


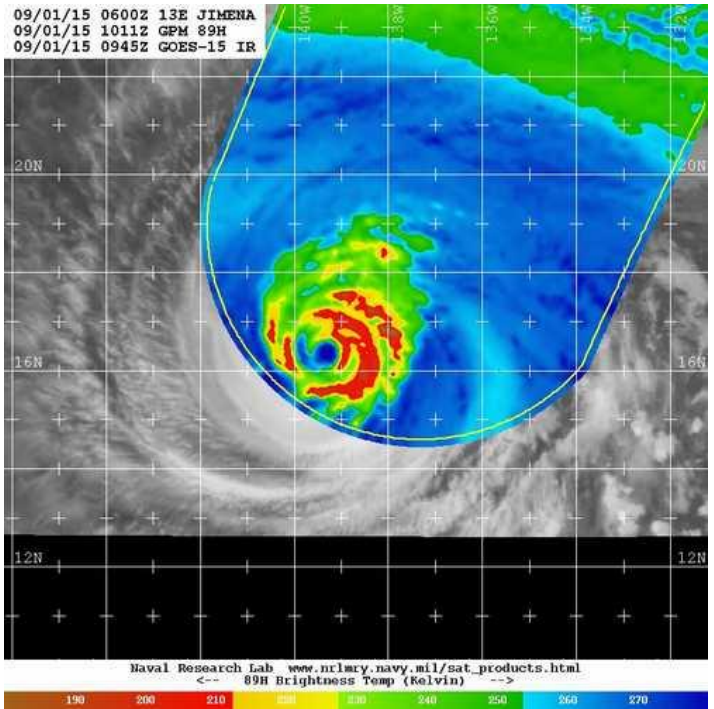




Microwave Environmental Observation

- Passive microwave observations have provided critical weather and climate data for over 30 years
- These systems have been costly and not suitable for small satellite constellations
- The Compact Ocean Wind Vector Radiometer represents a new low cost architecture for passive microwave weather sensors





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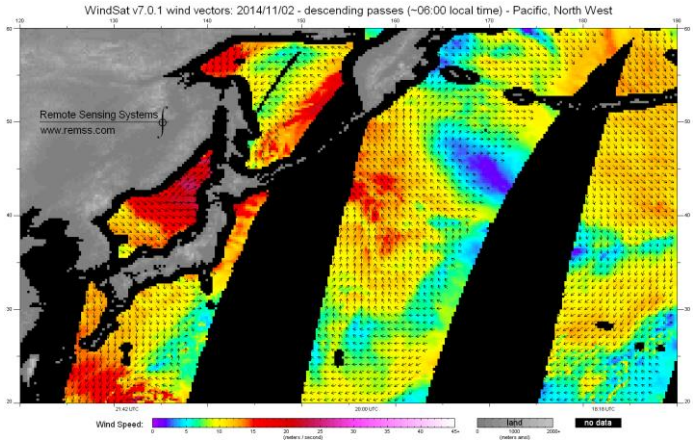
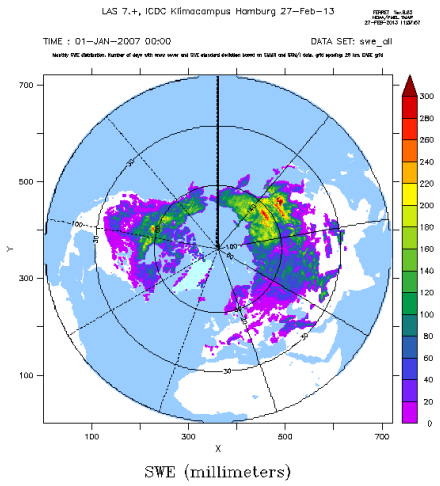
COWVR Measurement Capability

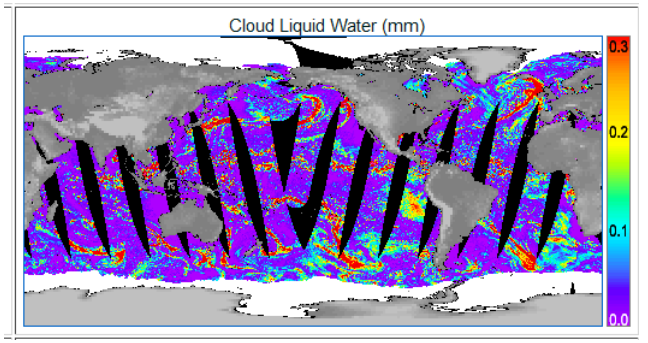
Ocean Surface Wind Vector



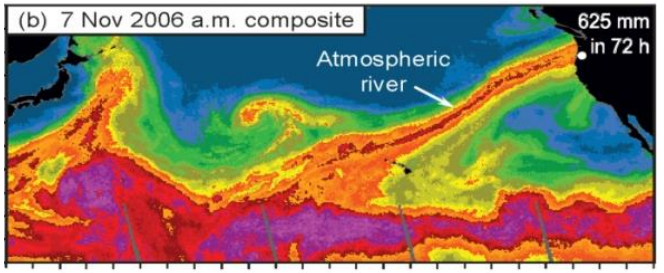
Snow Water Equivalent



Cloud Liquid Water

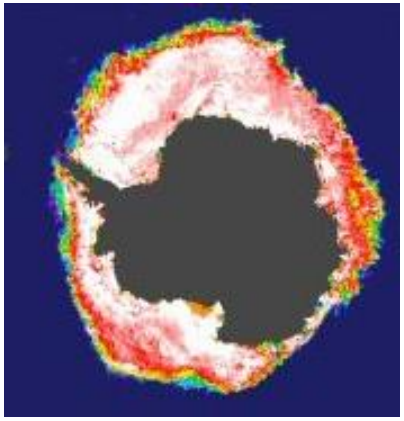


Precipitable Water Vapor

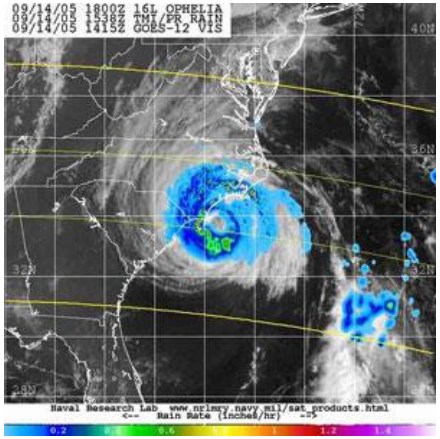


- 18 channels:
  - 18.7, 23.8, 33.9 GHz
  - V,H,+45,-45,LCP,RCP
  - < 0.3 K TB uncertainty
- 360º conical imaging
  - Rotation rate: 30 RPM
  - Spatial resolution: < 35 km
  - Swath width: 1012 km
  - Earth Incidence Angle: 51.7º

Sea Ice

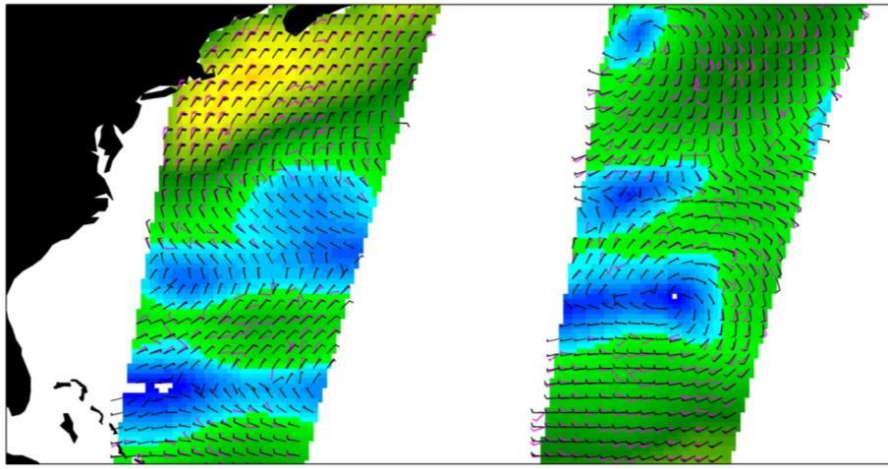


Precipitation

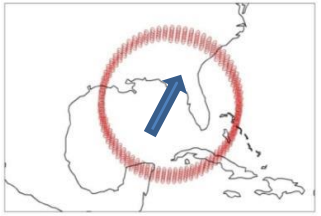


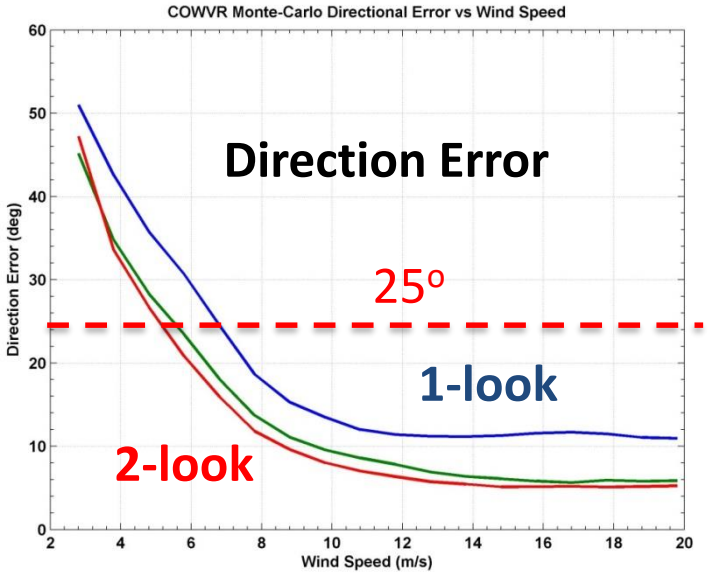
COWVR Unique 2-look Capability

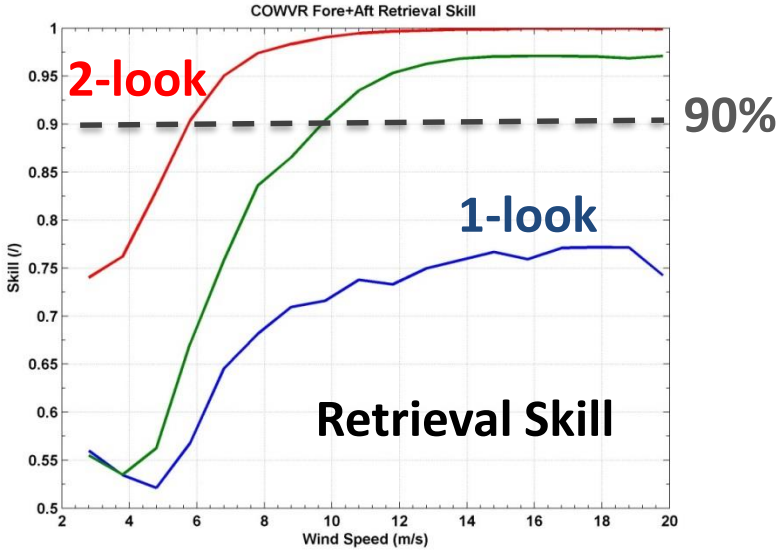
2-Look Algorithm



- COWVR has unique 360º unobstructed field of view
- COWVR wind direction retrieval performance benefits significantly from fore/aft viewing geometry (Hilburn et al., 2015)
  - Observations at two azimuth angles all but eliminate ambiguities
  - Improves performance at low winds







COWVR Technology Demonstration Sensor

- **The COWVR instrument is fully flight qualified and meets all performance objectives**

- **Expected to perform as well as, or better than prior 1-look radiometers (e.g. WindSat)**

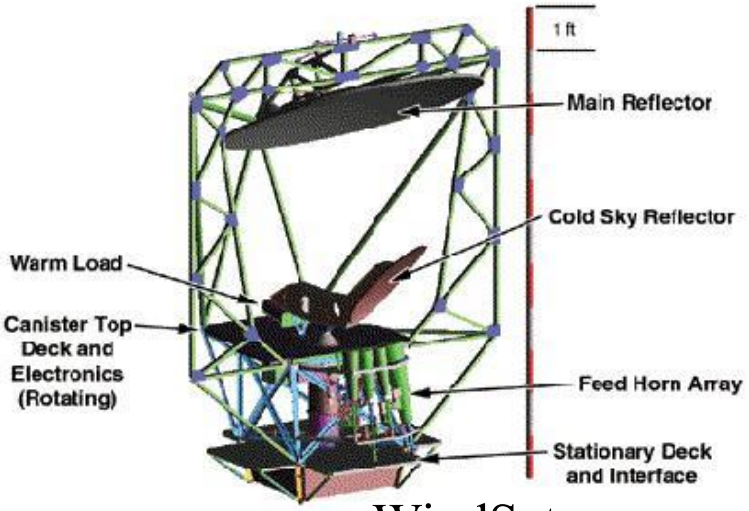
COWVR Sensor in TVAC Chamber

COWVR Wind Vector Error Pre-Launch Performance

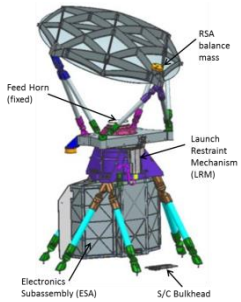
	Low Winds (< 6 m/s)	Moderate Winds (6 – 12 m/s)	High Winds (> 12 m/s)
Objective[1]	40°	17°	11°
	1 m/s	1 m/s	1 m/s
Threshold[1]	50°	25°	14°
	2 m/s	2 m/s	2 m/s
COWVR CBE	38°	16°	8°
	1 m/s	1 m/s	1 m/s

Unique COWVR Design

- COWVR novel design specifically addresses complex, costly and risky aspects of legacy sensor design
  - Electronic Polarization Basis Rotation technique eliminates complex and costly spin mechanism
  - Single broadband feed and compact MMIC receivers simplify radiometer assembly and significantly reduce mass/power/volume
  - Radiometer and electronics are stationary, minimizing the spun mass and thereby reducing spacecraft accommodation complexity



WindSat

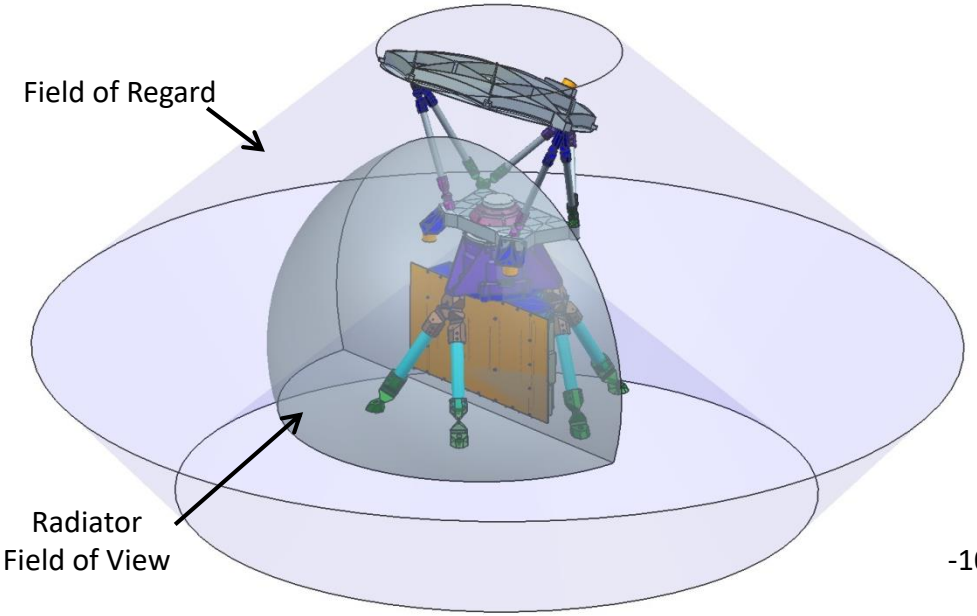


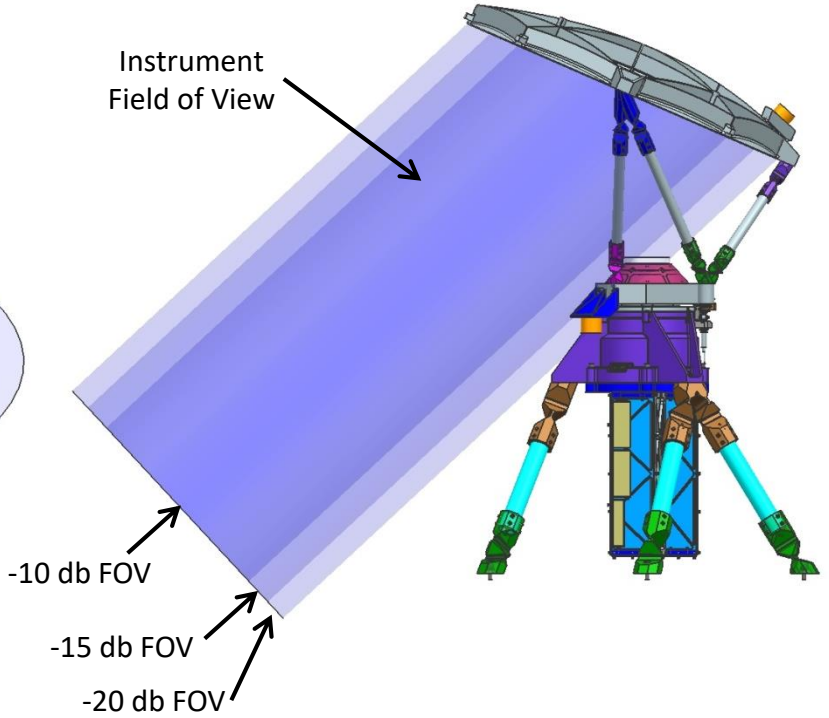
COWVR

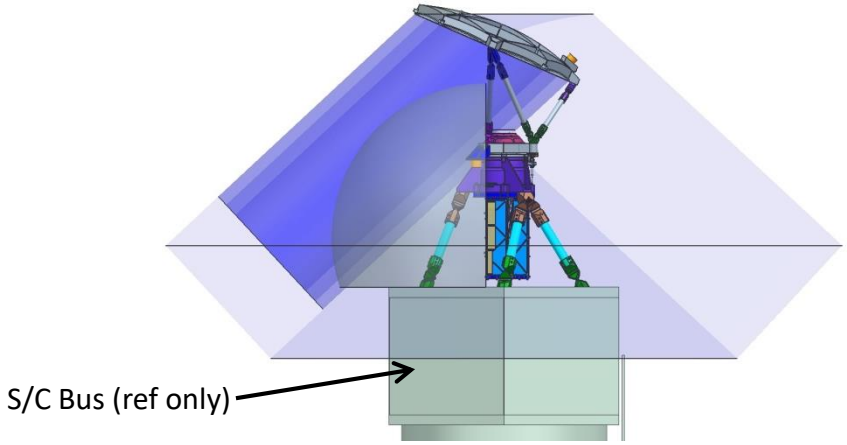
	WindSat	COWVR
Channels (GHz)	6.8 (x2), 10.7 (x6) 18.7 (x6), 23.8 (x2), 36.5 (x6)	18.7 (x6), 23.8 (x6) 33.9 (x6)
Feeds	11	1
Receivers	22 independent receivers	2 three frequency polarimetric receivers
Mass	330 kg	69.9 kg
Power	350 W	45.3 W (inst. power)
Spun Momentum	190 N-m-s	4 N-m-s
EDRs	Wind vector, TPW, CLW, precip, sea ice, SWE, soil moisture, SST	Wind vector, TPW, CLW, precip, sea ice, SWE

Relative size represented

Instrument Fields of View
(slide 1 of 2)



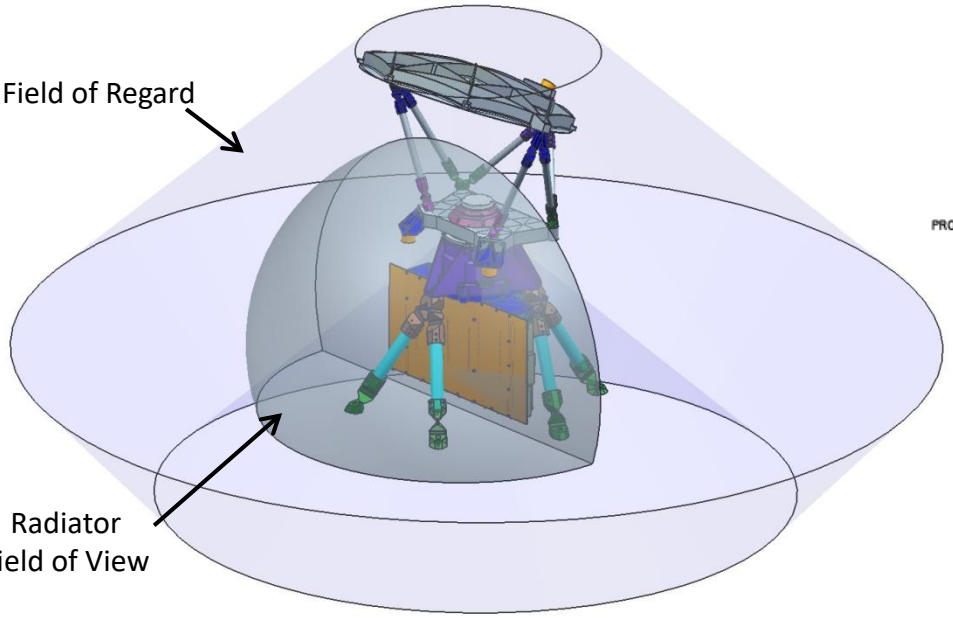


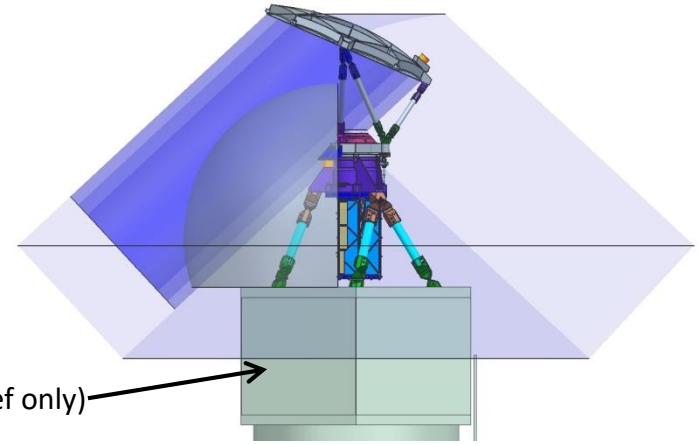


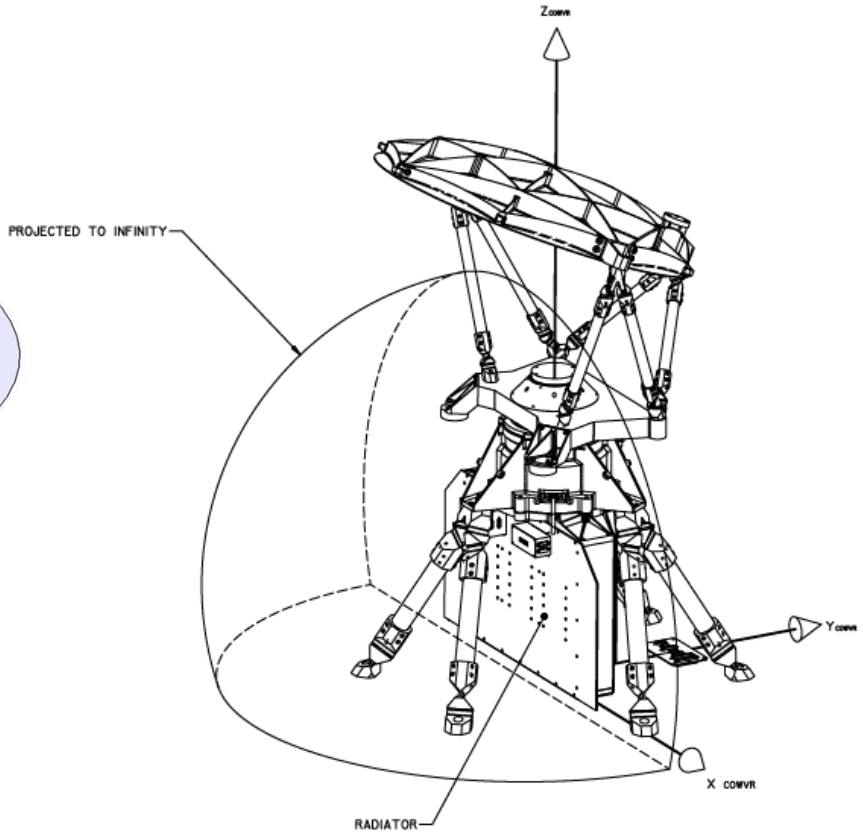
Reflector fields of view – Three defined to clarify consequences to instrument performance

- Impingement of -20 dB field of view (Ø 750 mm) must be reported to the payload operator; exceptions may be negotiated
- Impingement of -15 dB field of view (Ø 640 mm) must be analyzed for performance impact
- Impingement of -10 dB field of view (Ø 510 mm) is not allowed under any circumstances

Instrument Fields of View
(slide 2 of 2)







Radiator field of view projects to infinity in all directions outboard from the radiator, excluding the plane of the spacecraft top deck

Key Requirements and Interfaces

- Electrical interfaces
  - Communication via RS-422/UART
  - Bus provides system time message and PPS
  - Bus provides RS-422 discretes (COWVR assumes 2)
  - Bus power 28 ± 6V, independent high power and critical services (SHM)
  - Spacecraft controls 2 heater zones (optional, depending on orbit)
  - Bus monitored thermistors available for health monitoring

- Key Requirements
  - Spacecraft attitude knowledge 0.02^{o} 3-sigma
  - Unblocked 360^{o} field of view for the reflector
  - Spacecraft offsets COWVR spun momentum (~4 Nms)
  - Payload mounts to zenith deck of spacecraft

- Orbit
  - Polar, sun-synchronous orbit preferred
  - Ideal orbit is 6am/6pm terminator orbit for thermal reasons
  - Orbit altitude between 450-600 km
  - Other orbits can be considered, thermal is a driver